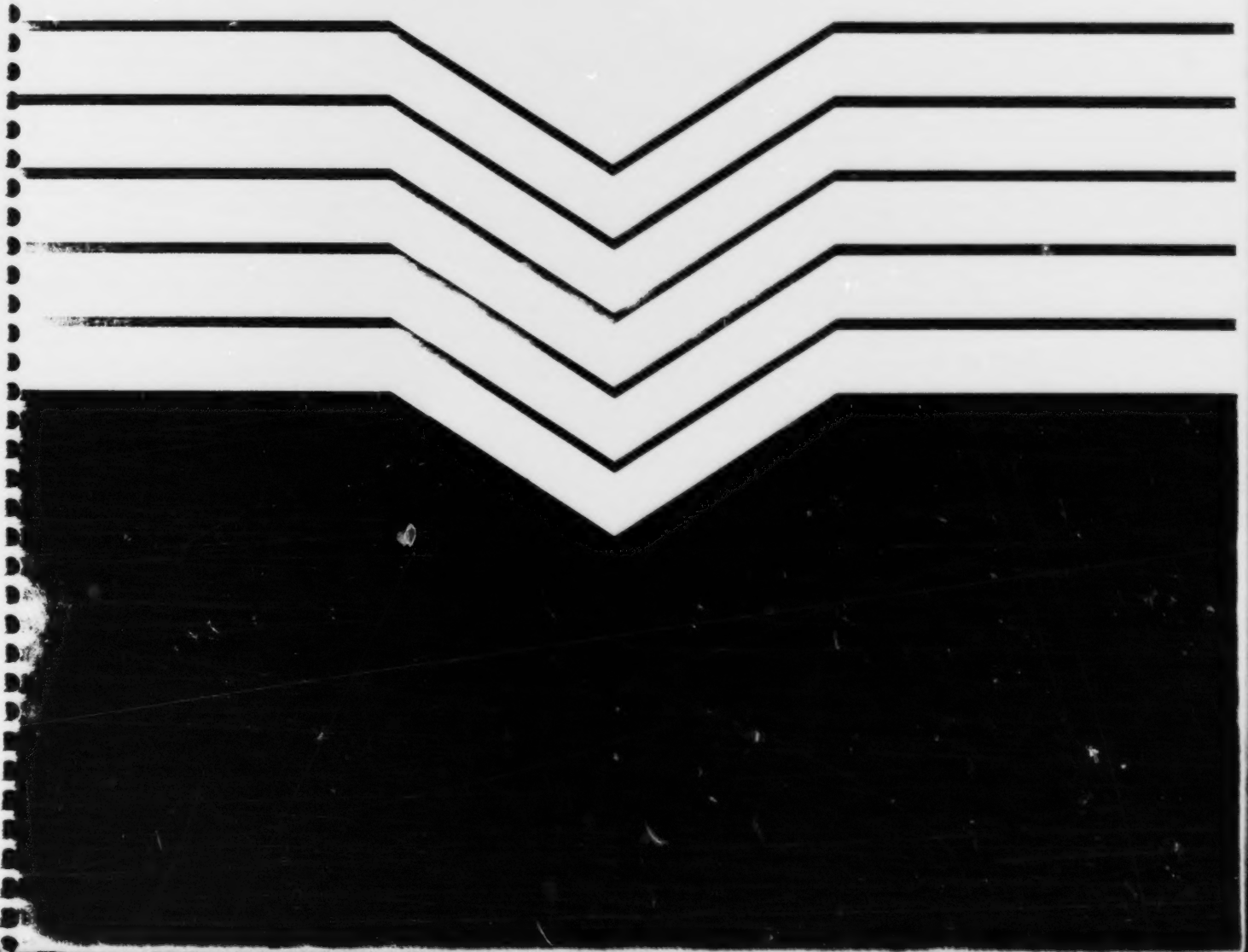
Energy, Mines and Resources Canada
CANMET
Canada Centre for Mineral and Energy Technology

Énergie, Mines et Ressources Canada
Centre canadien de la technologie des minéraux et de l'énergie

MINING RESEARCH PROJECTS

(EXCEPT FOR COAL)

FY 1987-1988



MINING RESEARCH PROJECTS

(Except for Coal)

Fiscal Year 1987-1988

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MICROMEDIA

86 pp

Foreword

This report contains summaries of all of the research projects which will be undertaken by the staff of the Mining Research Laboratories, of CANMET, Department of Energy, Mines and Resources, during the 1987-1988 fiscal year. The document, which was introduced last year, is intended to complement the Division's Annual Report and to serve as an additional means of making MRL's research plans known to both the private and public sectors.

The format follows parallels that were used by sister Divisions of CANMET. Each project is described by means of statements of objectives, background, and activity planned for the year. To facilitate further contacts the names and telephone numbers of the various project leaders are given.

The work of the Division involves the full-time in-house efforts of a staff of approximately 85 persons. Its mandate includes all mining research except for that devoted to carbons and hydrocarbons. Those are the responsibility of a sister Division, the Coal Research Laboratories, with headquarters in Devon, Alberta.

Apart from their own research, MRL staff are also responsible for the supervision of a large number of research contracts. Largely as the result of the Mineral Development Agreements between the Federal and Provincial governments, the number of such projects has increased rapidly. In dollar terms almost 50% of the funds allocated to the Division are now devoted to the contracting of significant parts of the research program to the private sector. The trend is towards external large-scale field demonstration type projects. It follows that MRL's contacts with the mining industry are being enhanced considerably.

A list of all of the research contracts in effect for the current year is given as Appendix A to the report.

Since the purpose of this document is to facilitate the dissemination of information, responses to it are invited. Either the undersigned or the project leaders listed would be pleased to try to answer questions and to try to provide any further information that may be required.

John E. Udd, Ph.D., P.Eng.,
Director,
Mining Research Laboratories
(613) 996-4570 (ext. 150)

Avant-Propos

Le présent rapport contient les résumés de tous les projets de recherche qui seront entrepris pendant l'année fiscale 1987-1988 par le personnel des Laboratoires de recherche minière du CANMET, Ministère de l'Énergie, Mines et Ressources. Ce document, qui fut présenté l'année dernière, se propose de compléter le rapport annuel de la division et de permettre une plus grande connaissance, tant pour le secteur privé que pour le secteur publique, des projets de recherche des LRM.

Le format est très semblable à ce qui a été fait par les autres division du CANMET. Chaque projet est décrit en termes d'objectifs, d'activités antérieures et d'activités prévues pour l'année qui vient. Pour faciliter l'accès à l'information, les noms et numéros de téléphone des chefs de projet sont inclus.

L'effort de travail de la division implique environ 85 personnes à temps plein. Son mandat couvre toutes les recherches concernant l'exploitation minière, exception faite des recherches sur les carbones et les hydrocarbures. Celles-ci sont sous la responsabilité d'une autre division du CANMET, soit les Laboratoires de recherche sur le charbon dont le siège central est situé à Devon en Alberta.

Mis à part les projets de recherche interne, le personnel des LRM est aussi responsable d'un grand nombre de contrats de recherche. Conséquence des Ententes sur le développement minéral entre le gouvernement fédéral et les provinces, le nombre de ces projets a considérablement augmenté. En termes de financement, presque 50% des fonds alloués à la division servent à des contrats de recherches réalisés par le secteur privé. La tendance actuelle est vers la réalisation de projets à grande échelle de démonstration sur le terrain. Il s'en suit que les contacts des LRM avec l'industrie sont en pleine progression.

Une liste de tous les contrats de recherche en cours cette année est donnée à l'annexe A.

Comme le but de ce document est de faciliter l'accès à l'information, tout commentaire sera le bienvenu. Les chefs de projet qui sont mentionnés ici, ainsi que moi-même, se feront un plaisir de répondre aux questions ou de fournir toutes informations qui pourraient être utiles.

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Appendix A

PART I

ADMINISTRATION OF THE CANADA EXPLOSIVES ACT

Certification and Technical Advice

Project Leader: E. Contestabile
(613) 995-1363

Person Years - 8.0
A-Base Operating and Maintenance - $400,000
Contracts - $0.00

Objective:

On a continuing basis: to confirm the safety characteristics of all explosives submitted annually for authorization under the Canada Explosives Act; to provide technical advice on the manufacture, storage and transportation of explosives, and to investigate accidents.

Background:

All explosive products, including ammunition and fireworks, must be authorized under to Canada Explosives Act prior to use in Canada. New explosives submitted for authorization need to be evaluated to assess any peculiar safety hazards related to the product, its manufacture, transportation, storage and use. This testing and evaluation is done at CANMET. Those explosives which do not present unusual hazard are recommended for authorization. In addition, production explosives are monitored on a continuing basis to ensure that prescribed standards are met.

As new types of explosives are developed, new test standards need also be developed to ensure proper and reliable evaluaton of possible hazards before they can be implemented.

Technical advice on explosives and explosion hazards is provided to various government departments and agencies, industry and the public. Accidental explosions are investigated on an "as required" basis.

Technology Transfer:

a) Organizations involved: Authorization of explosives, technical advice and accident investigations are services provided to federal departments, provincial governments, industry and the general public.

b) Mode of Technology Transfer: Reports, meetings, telephone calls.

c) Time Frame: Fiscal year 1987/88.

Planned Activities for FY 1987/88:

a) The Canadian Explosives Research Laboratory will evaluate all submitted advice onsamples in 1987/88 (approximately 350 investigation reports).
b) Technical advice on the manufacture, storage and transportation of explosives will be provided on an "as required" basis in 1987/88.
c) Investigation of accidental explosions will be on an "as required" basis in 1987/88
d) 1) Completion of Canadian standards for pyrotechnic articles, - December 1987.
   2) Evaluation of Propagation Hazards of Class 7.2.2 Display Shells for Explosives Branch, July 1987.
   3) A review of factors that can affect the quantity - distance storage requirements for propellants, March 1988.

NOTE: Milestone d)(3) is a contract in the amount of $75K.
Successful completion will depend on funding being found.

Explosives R & D

Project Leader: K.K. Feng
(613) 998-0461)

Person Years - 6.0
A-Base Operating and Maintenance - $391,000
Contracts - $10,000

Objective:

To advance technology related to the manufacture, storage, transportation and use of explosives.

Background:

Explosives R & D at CANMET is primarily directed at furthering our technical capability to reduce safety and health risks involved in working with explosives.

CANMET efforts over the past few years have been directed to the development of mathematical models to predict explosives properties and detonation parameters in order to avoid the need for extensive field testing of explosives to determine, for example the levels of toxic fumes produced on detonation.

A new fume testing facility is under construction to measure experimentally toxic fumes. Studies are underway to develop a mathematical model to predict the consequences of vehicle transporting explosives being involved in collison (low velocity impact). The effects of temperature and fire on explosives during manufacture, storage and transportation are being investigated.

Methods to determine properties of explosives are continually being developed or improved as new types of explosives are marketed. In order to contribute to risk analysis methodology, new types of explosives are studied in depth to fully characterize them.

An additional thrust will be the study of properties of explosives, including detonators, on their use in mining and civil engineering projects. These properties will include propagation sensitivity and time delay of detonators.

Technology Transfer:

a) Organizations Involved: Outputs are to develop knowledge and new techniques to identify explosive hazards. Preliminary recipients

are the Canadian explosives industry and federal regulatory agencies.

b) Mode of Technology Transfer: Reports and siminars.

c) Time Frame: Specific outputs as noted above.

Planned Activities for FY 1987/88:

1) Review of the effects of detonator properties on rock fragmentation - Report December 1987.
2) Establishement of a new fume testing facility and initial report on evaluation of detonation products - July 1987.
3) Theoretical kinetic analysis of experimental data obtained on thermal decomposition of explosives - Report December 1987.
4) Low Velocity Impact - Final Contract Report - December 1987.

PART II

MINERAL AND ENERGY TECHNOLOGY

MINING METHODS AND EQUIPMENT

Mine Methods and Evaluation

Project Leader: J. Pathak
(613) 990-4011

Person Years 2.1
A-Base Operating and Maintenance - $130,000
Contracts - $16,000

Objective:

On a continuing basis, to develop and evaluate mineability and mine operational economic criteria, for hard rock mining in Canada, and to prepare biennial estimates of planned and projected production capabilities of uranium mines.

On a demand basis, to make technical/economical evaluations of mining project proposals submitted by outside departments or agencies.

Background:

Technical and economic evaluation of existing and potential uranium mining operations is an essential component of uranium reserve and resource assessment, which has been assigned to CANMET on behalf of EMR Energy Policy Sector. In addition, reliable estimates of uranium production capabilities for individual properties, plus projections of future production, are also required for the EMR Uranium Resource Apppraisal Group (URAG). Resulting in information on Canadian uranium reserves, resources and production is required as is input to policy decisions on domestic and export sales quotas for each projected and operating unit in Canada, as well as the granting of production licences by Atomic Energy Control Board (AECB).

To meet the above commitments it is essential for CANMET to acquire realistic production cost data in order to develop adequate mine operations evaluation procedures, and to establish a base of unit productivities related to existing and developing mining technologies. Computer techniques will be used where feasible.

The development of such data bases and expertise, fortunately, is generally applicable to all hardrock mining operations. This will result is a general mine evaluation capability in MRL/CANMET which will be of value to government policy organizations, as well as to the Canadian mining industry.

Technology Transfer:

URAG operations require continuing close working contact with many Canadian mining operations, as well as those with production potential. Also, specific mine evaluation exercises may be expected to be required for other hardrock mining operations for government policy purposes, involving personal industry contacts.

Publications summarizing new evaluation development techniques are projected, to transfer relevant information to the Canadian mining industry.

Computer cost data for small underground hardrock mine evaluation will be developed. There will be available to small entrepreneurs.

Planned Activities for FY 1987/88:

1) Report on Canadian uranium production capability, deposit by deposit (annual).
2) Writing of ventilation network instrumentation manual for use with PC computer (1987).
3) Critical review of mining proposals/feasibility studies on demand.

Advanced Mine Equipment Technology

Project Leader: J. Pathak
(613) 990-4011

Person Years - 2.0
A-Base Operating and Maintenance - $114,000
Contracts - $16,000

Objective:

To assess the potential productive impacts of worldwide developments in new mining equipment and other pertinent advanced technologies, e.g., automation and robotics.

By 1989; to characterize the dust produced by major sources in hardrock mines and to assess dust control measures; to demonstrate the capabilities of environmental monitoring systems.

On a continuing basis; to conduct reviews of mine equipment and prepare state-of-the-art reports; to promote the development and demonstration of new mine equipment/equipment systems in all parts of the mining cycle.

Background:

The Canadian mining industry is facing its toughest competition from the third world countries. To remain competitive in the international market it has to find the ways and means of improving management, productivity, safety, mine environment, equipment availability and utilization and to reduce cost, waste, manpower, material requirements and energy.

Successful application of microprocessors, sensors, data transmission, monitoring and control systems in various manufacturing and processing industries have given reasons for their applications to underground hardrock mining. There exists considerable potential for transfer of the technology to mine equipment automation, remote control and optimization. The systems will be designed to store all pertinent information regarding performance of equipment, and will also be used for preventive maintenance, thereby increasing its availability.

Technology Transfer

Projects and equipment development selected will have direct applicability in the mines. The aim will not be just the domestic market but also export potential.

Planned Activities for FY 1987/88:

1) Contract report on mine equipment development and its relationship to mine operations (1987/88).
2) Report on blasthole depth measurement test set development (1988).
3) Evaluation of dust control methods in hardrock mines (1988).
4) Development of a mine status indicator system (concept 1987); sensors; hardware and system (1988/90).
5) Conceptual development of a demonstration project for a fully instrumented mine (1987) - demonstration of the project (1988-91).
6) Report on a Conspec system and evaluation of sensors (1987-91).
7) Two reports: (1) effects of oil leakage on respirable combustible dust; and (2) use of CO2 as a surrogate for toxic diesel emmission (1987/88).

Canadian Mining Technology Coordination

Project Leader: J. Pathak
(613) 990-4011

Person Years 1.3
A-Base Operating and Maintenance - $75,000
Contracts - $0.00

Objective:

To promote cooperation and improve efficiency in the Canadian mining industry by maintaining a national information bank on current and developing mining technology in the mining industry, and by preparing state-of-the-art reports on mine operational problems.

Background:

Some progressive mine operating companies are, on a continuing basis, collaborating with consulting firms, equipment manufacturers, universities, Government R&D, research foundations etc. to improve and develop the state of mining technology. Many companies are also involved in in-house research which is aimed at improving their own operations but could be applied to others in Canada. Because their results are generally not published or made known to potential beneficiaries, the technological impact of their research is not felt nationally. To disseminate this knowledge, MRL has undertaken to collect information on these research/project/activities of these organizations, to compile these and to distribute the compilation to the mining industry. This can be a valuable contribution to mining technology development in Canada.

Technology Transfer:

The essence of this project is technological interchange among all organizations in Canada interested in mining research and mining technology development.

Planned Activities for FY 1987/88:

1) Development of a computer database from the Index (1988).
2) State-of-the-art reports on aspects of operational Canadian mine technology (1988).
3) PC software for use with the mine cost estimation manual previously prepared by Redpath Ltd. (1987).

Materials Handling & Operations Research

Project Leader: N. Billette
(613) 990-4011

Person Years - 2.7
A-Base Operating and Maintenance - $147,000
Contracts - $13,000

Objective:

To develop the concept of optimizing materials handling systems for both underground and open pit mines.

By 1991; to develop mathematical models for calculation of heat transfer in different media and mine segments.

By 1990; to apply computer techniques/graphics/simulation for optimization of various mine functions and to improve mine design capability.

As a part of a study to modify an existing program, which permits haulage selection to optimize blending for use with polymetallic mine deposits: carry out reserve studies of suitable deposits to accurately establish the grade and spatial distribution of metals and minerals and to establish functional relationships between individual metals and minerals taking into consideration their physical/chemical properties.

Background:

Since the start of the metals price depression in the early 1980's, the Canadian mining industry has realized that it needs to move ahead of the world mining technology in order to maintain its competetive edge. Beside deployment of reliable and proven equipment, application of mathematical modelling (OR) and computers could optimize utilization of mine equipment, such as truck transportation or trolley-assisted haulage system in open pit mining, enhancing the productivity. Automation and robotization of trucks in open pits could mean a savings of $150,000 to $200,000 per operating truck.

Other avenues where an impact on time and skilled labour saving could be made is the CAD/CAM equivalent system development for mine design. This which could also optimize an expensive mine development. The objective of the project will be to increase computer usage and better management information techniques of the type which already exist in the manufacturing and process industries.

Technology Transfer:

Some of the work undertaken will be site-specific with the results transferable to others. Most of the software developed will be user-friendly and will be based on most commonly used PCs in the mines. All the research carried out will be of an "applied" nature for direct use by operators.

Planned Activities for FY 1987/88:

1) Haulage automation for open pit mines with integration of blending: a study on first polymetallic orebody planning procedures will be carried out and reported (1987/88).
2) CAD system for small underground mines (3-dimensional) (1987-91): development of work plan (1986).
3) Mine information systems programming - progress report on MDA contract (1987/89).
4) Completion of demonstration projects on new improved open pit mine haulage technology (1991).
5) Mathematical model for heat balance and recovery of heat from mine exhaust air and water (1988-91)..
6) Study report on second polymetallic deposit (1988/89).

Evaporite Mining Methods

Project Leader: G. Herget
(613) 996-4570

Person Years - 1.4
A-Base Operating and Maintenance - $87,000
Contracts - $97,000

Objective:

To increase potash recovery over current levels by carrying out contract research in the areas of ground control, environmental control and productivity. Ground control is focussing on the prediction of mine opening behaviour and the effects of back fill on stability.

Background:

On May 17, 1983 the Minister of Energy, Mines and Resources announced the coming into force of the a (2) year START Program (Short-term Aid in Research and Technology) to assist the Canadian mining industry.

One of the thrusts provided for under START covered research and development contracts with short-term industrial benefit. The current recovery rate of Saskatchewan potash is 40% and, though profitable, represents a significant loss of resources, as well as profit. This is due in part to increased underground transportation.

A two-year program of contract research under START ($250,000/year) was completed by MRL with the participation of the potash industry. A total of eight contracts which addressed questions of mine design ground control and monitoring of dust were completed. Technology transfer continues.

Technology Transfer

Seminars, publications and CANMET reports.

Planned Activities for FY 1987/88:

1. Report on laboratory testing of waste salt as backfill, creep tests on in situ samples, in situ monitoring and numerical modelling development under the New Brunswick Potash Mineral Development Agreement (MDA).

2. Report on the monitoring and numerical modelling of excavation behaviour at Cominco potash (1987).

3. Numerical analysis for a new mining layout incorporating backfill (1988).

4. Second contract report on in situ demonstration trial under the Canada/New Brunswick MDA (1988).

5. Propose a new approach for mining Saskatchewan potash (1989).

Canada/New Brunswick Mineral Development Agreement

Project Leader: R.W.D. Clarke
(613) 995-1147

Person Years - 0.0
A-Base Operating and Maintenance - $0.00
Contracts - $96,000

Objective:

To improve productivity and safety in the New Brunswick mining industry by development of mines services software and other projects currently under negotiations. Contract research is being carried out to improve the productivity and safety of underground metal mines by developing a Mine Service Software System for general use. Research is also being carried out to increase potash recovery over current levels through developing the technology to use effectively waste salt as a backfill material for support.
(See project 140905 - Evaporite Mining Methods).

Background:

Mine service software systems are being developed by some of the larger Canadian mining companies to improve the efficiency and safety of their operations and to upgrade their mine planning methods. A number of small and medium mines could benefit from the introduction and use of this technology. Many, however, are not in a position, financially or technically, to take advantage of this new mine technology. This project will develop a system which, with modifications, will be generally applicable to Canadian hardrock mines.

Technology Transfer:

The following methods of technology transfer are available:

- Technology transfer seminars on contracting debriefing sessions;
- Preparation of technical/contract reports, and/or publications in scientific/technical journals.

Planned Activities for FY 1987/88:

1. Design, development and field evaluation of a Mine Service Software System suitable for general use by Canadian underground hardrock mines (March 1989).

ROCK MECHANICS

Mine and Regional Stability

Project Leader: D. Hedley
(705) 848-2236

Person Years - 3.0
A-Base Operating and Maintenance - $186,000
Contracts - $10,000

Objective:

To evaluate pillar stability on a local and regional scale in Canadian hardrock mines; determine pre-mining stresses in rockburst-prone mines in mine structures, especially around weakness planes.

Background:

CANMET has maintained an extensive program of in-mine rock mechanics R&D over many years. The prime thrust of this work in underground mines has been to improve the safety of operations, both in the immediate local sense and for mine districts, while contributing to mining method advances which permit improved productivity.

Guidelines for design and operating parameters relating to rock structures in mines have been developed and implemented at mines as a result of this research. Now, mines wish to extend to greater depths and to improved productivity by application of new bulk mining methods.

Commensurate further developments in rock mechanics technology are also required. In particular, there is a need to develop a better theoretical base for design, and to lessen the dependency on empirical methods which are of limited use for predicting rock behaviour in new situations.

High ground stresses are encountered in mines at depth and where relatively high extraction ratios concentrate existing ground stress fields. The end results of these high stresses can be pillar failures, either gradually, or violently in the form of rockbursts.

In recent years, computer programs have been developed which are capable at reasonably predicting stresses on fairly complex mining layouts. The other side of the coin, predicting rock strength, is still empirically based to a large extent. More research is required, especially using stiff-testing machines, to determine post-failure rock behaviour and its potential for rockbursting.

Technology Transfer:

The following methods to transfer technology will be used.

1. Joint projects with industry;

2. Meetings with company, union, regulatory officials;

3. Jointly authored technical reports with industry;

4. Participation in industrial seminars.

Participants in this project are Campbell Red Lake Mines Limited, Rio Algom Limited, Denison Mines Limited, INCO Limited, Falconbridge Limited, Lac Minerals Limited.

Planned Activities for FY 1987/88:

1. Development of rock mechanics knowledge for the design of yielding pillars and

2. To assess regional/mine stability associated with a bulk mining method and develop guidelines for extraction sequence, stope-pillar dimensions, ground control (Detour Lake Mine) (1991).

Rock Mass Characterization

Project Leader: M. Bétournay
(613) 995-1147

Person Years - 2.0
A-Base Operating and Maintenance - $124,000
Contracts - $0.00

Objective:

To evaluate the influence of discontinuities, backfill and other support systems on rock mass stability, especially for surface crown pillars.

Background:

The Selbaie Mine represents an extreme example of surface crown pillar conditions. Well fractured and highly altered, it represents a challenge to the safe and economical extraction envisaged. A contract previously awarded to Mirza Engineering covered sampling, testing, modelling and monitoring aspects of that surface crown pillar. The report will also identify which are the critical parameters to consider for design in such settings.

It is recognized that some specific structures in mining have special stability and support requirements. In these cases, such as for surface crown pillars, special attention is required to delineate the reasons for stability/instability of such structures and the best methods of retrieval of critical parameters. Evaluations of stability and support requirements must be made in the context of the operator's mining activity.

When properly included in a valid design approach, rock mass characterization provides the focus for dealing with surface crown pillars. Because of the uniqueness of these mine structures, in a material and comparative sense, such characterization must employ methods and equipment used in the fields of mining and civil engineering. There would benefit from the availability of a surface crown pillar specific characterization system. Such a system would be applicable to large, multiple openings common in mining and would supply an understanding of how the rock mass interacts with support systems, such as backfill.

A multi-year program is underway to develop, with the cooperation of the mining industry, crown pillar design guidelines. The assemblage of a comprehensive set of case histories will be completed shortly.

All of the work performed by the contractor is original and will establish new methods of sampling weathered rock and new ways of modelling using a soil-rock numerical model. New monitoring techniques will also be tested for this terrain.

The resulting technology will benefit any future or presently operating mine with similar problems.

The surface crown pillar hand book will have a significant impact on the ability to address this condition. Prior to this CANMET effort, there was a lack of information on the subject. The handbook, by combining the information from different fields and various case studies, will provide the operator with all of the tools; recognition of key elements for design; step-by-step procedures for site investigations, data analysis; analytical and modelling techniques; support measures; monitoring. This will include advantages, disadvantages and limitations so that the operator can best choose in accordance with local needs. CANMET is also sponsoring and developing research, such as modelling, field sampling and investigations, monitoring techniques.

Planned Activities for FY 1987/88:

1. Review of design guidelines for surface crown pillars (1987).

2. Evaluation of support systems, including backfill, for weak rock masses (1987).

3. Formulation of a handbook on surface crown pillars for safe and economic design (1988).

4. Formulation of new deterministic, probalistic and empirical methods and solutions for the stability of surface crown pillars (1989).

5. Reports on the evaluation of the stability of a test surface crown pillar (1989).

Rock Properties and Support Systems

Project Leader: M. Gyenge
(613) 996-4570

Person Years - 2.0
A-Base Operating and Maintenance - $124,000
Contracts - $15,000

Objective:

On a continuing basis, to establish the strength, deformational and other properties of a variety of rock types.

By 1987; to commission a new servo-controlled rock test system, and, by 1989, to report on the significance of rock matrix properties in relation to the occurrence of rockbursts.

Background:

Active mining at an increasing number of underground mines involves stress conditions where the post-peak strength properties of the rock must be taken into account in strata mechanics investigations.

Studies are underway to develop methods and equipment to establish the post-peak strength properties of rock, as well as those of rock mass joints under high normal loads.

The performance of a number of artificial support systems under high stress conditions is also being investigated. Research is directed at extending existing design guidelines to mines at greater depth or under greater stress.

Technology Transfer:

The following methods of technology transfer will be used:

1. Joint projects with the industry.
2. Technical discussions with company engineers.
3. Technical reports, publications, guidelines, workshops and presentations.

Planned Activities for FY 1987/88:

1. Report on new rock bolting guidelines for hardrock (1987).

2. Report on the joint properties of various rock types (1987).

3. Publication of guidelines for laboratory test procedures for rocks (1988).

4. Report on parameters affecting rockbursts (1989).

5. Preliminary report on the laboratory parameters for the strength classificaton of rocks (1990).

Numerical Model Development

Project Leader: Y. Yu
(613) 996-4570

Person Years - 3.6
A-Base Operating and Maintenance - $223,000
Contracts - $15,000

Objective:

On a continuing basis to conduct studies related to mining; to develop guidelines for designing underground openings; and to develop numerical models and software packages in a form which is suitable for use with either personal or micro-computers at small mining operations.

By 1987; to implement new computer models for evaluating stability of underground openings and mining-related structures.

By 1990; to upgrade software packages and hardware capabilities for mining and geotechnical applications.

Background:

In mining, the prediction and evaluation of rock mass behaviour is becoming progressively more important for mine design and planning. The uses include the selection of mining methods, layouts, stope and pillar dimensions, and mining sequence, as well as for ground control and support requirements. The explicit theoretical solutions are usually not available, and are perhaps extremely difficult, or impossible to obtain, because the ground characteristics are always complex.

The complexity depends on factors including geological structural features, rock types and mine geometry. Physical models are proven to be expensive, take time to make, and are impractical and unreliable. Numerical models are desirable and are being accepted as alternative methods for predicting the stresses and displacements which will be induced in the rock mass as a result of mining.

There is a need, however, to develop and implement numerical models based on combinations of the principles of modern rock mechanics and practical rock engineering in order to provide a reliable means for predicting ground behaviour of both underground and open pit in a more scientific and rational manner.

Technology Transfer:

The following methods of technology transfer are foreseen:

1. Applications of numerical modelling techniques to mine design, in joint projects with the mining industry.

2. Provision of software packages to industry, universities ... etc.

3. Preparation of technical reports, publication of significant results in journals, and attendance at conferences.

Planned Activities for FY 1987/88:

1. Stability evaluation of Canadian mines involved in CANMET's Cooperative Research Projects (1987-92).

2. Attempt to verify certain numerical techniques for analyzing mine structures using field measurements (1987-92).

3. Investigation of interactive graphics for mining applications (1987).

4. Design guidelines for underground mine openings (1989).

5. Assessment/implementation of software packages to be used with micro-computers for small mining operations (1992).

Underground Nuclear Waste Repository

Project Leader: M. Gyenge
(613) 996-4570

Person Years - 2.5
A-Base Operating and Maintenance - $155,000
Contracts - $0.00

Objectives:

To determine the thermal-mechanical properties of rocks from study areas in the nuclear waste management programs, including anisotropic characteristics; to develop equipment and methods for studying scale effects on shear properties of rock; to establish the thermal cracking potential of the study area rock formations; and to prepare geotechnical program documents in support of concept assessment submissions by AECL.

On a continuing basis: to participate in field studies at AECL's Underground Research Laboratory (URL) site; and to monitor the response of the rock mass surrounding underground repositories using microseismic methods, if incremental funds are available.

Background:

Nuclear waste disposal - particularly of spent fuel rods - will become a critical aspect of nuclear electricity generation. CANMET's program is a part of Atomic Energy of Canada Ltd's long-term strategy for investigating disposal at depth in stable geological formations. CANMET's geotechnical and mineralogical expertise is used to determine how rock behaves under the high temperatures associated with decaying radioactivity.

Technology Transfer:

Methodologies and data will be incorporated into submissions made to regulatory agencies for approval of the concept of deep disposal of nuclear waste in plutonic structures. In the interim (regular, yearly) open meetings with the geoscience community, and yearly review by an expert geoscience review committee, reports and publications are the methods of technology transfer.

Planned Activities for FY 1987/88:

1. Large scale direct shear tests on URL joint block samples (1988).

2. Thermal-mechanical rock properties on samples from Lac du Bonnet Batholith (1988).

3. Completion of field experiments (1989).

4. Final report on thermal-mechanical rock properties and field experiments (1989).

5. Completion of geotechnical studies documents (1990).

Instrumentation Development

Project Leader: G. Herget
(613) 996-4570

Person Years - 1.0
A-Base Operating and Maintenance - $62,000
Contracts - $24,000

Objectives:

To develop and test field geotechnical instrumentation, specifically:

By 1987: to develop and test a rugged side-viewing borehole T.V. inspection unit and long term deformation monitoring equipment;

By 1987; to develop a plan for expanding instrumentation development work and for recording costs on instruments on loan;

By 1988; to develop high precision borehole deformation monitoring equipment including, electronic data acquisition.

Background:

A wide variety of instrumentation has been developed over the years but very little objective testing and field evaluation has been carried out. MRL is in the unique position of having mine access and know how to evaluate various types of instrumentations in regard to performance criteria and usefulness. New developments are required for borehole inspection by small diameter T.V. cameras. This would assist in stability assessments for excavation roofs and evaluation of design assumptions.

In addition, stress monitoring equipment for boreholes needs to be developed. A study is also necessary to identify, for potash mine design, suitable instrumentation for field exploration of deformation modulus and creep data. Brine locations in potash are a major concern in potash mines. Forcemeters require development and field assessments of stabilities of readouts and their usefulness for assessing ground vibrations during blasting trials and the safety of U/G structures when subjected to dynamic shock.

Technology Transfer:

1. Publications in mining journals.
2. Seminars in mining camps.
3. Demonstrations to equipment manufacturers.

Planned Activities for FY 1987/88:

1. Rugged, portable, small, side-viewing borehole T.V. inspection tool (1987).

2. To develop long term high precision deformation monitoring equipment for boreholes (1987).

3. Electronic data acquisition system suitable for lap top computers (1988).

Canada/Manitoba Mineral Development Agreement

Project Leader: R.W.D. Clarke
(613) 995-1147

Person Years - 0.4 PY A-Base
Operating and Maintenance - $23,000
Person Years - 1.0 MDA
Operating and Maintenance - $35,000
Contracts - $324,000 MDA

Objective:

By 1989; to develop Vertical Block Method (VBM) design guideleines; safer procedures for scaling loose rock; a geotechnical data base and numerical package for the design of underground openings at depth; ground stability evaluation criteria for en-echelon lensed ore-bodies; to identify, demonstrate the use of an underground communication system based on existing technology.

Background:

New mining techniques, such as vertical blasthole methods, create large expanses of hanging wall (and footwall) not found in cut-and-fill stoping. It is essential to predict how the ground will behave before it is mined. Modelling is the key to relating pre-mined strength and inherent stresses to the post-mined configuration and is predicated on information which details rockmass character. This type of planning allows many "runs" to test various parameters and their sensitivities.

To properly control the ground, a better understanding of ground behaviour and its response to mining, and the causes of instabiity, is considered essential. Therefore, studies in the area of rock mass behaviour, mine stability, sophisticated numerical modelling and improved mining technology are planned.

In underground mines, there is also a need for more effective communications systems. Current warning systems for fire hazards, in which stench gas is injected into mine air, are inadequate for remote working areas located at the ends of long ventilation systems. A reliable communications system, which permits underground personnel to maintain communications almost any where within the mine, and with the surface, will be installed and evaluated.

A communications system for voice and data also completes the requisite infrastructure for automation of underground mobile equipment.

Technology Transfer:

The following methods of technology transfer are envisaged:

1. Preparation of technical/contract reports, and/or publication of results in scientific journals.

2. Technology transfer seminars or contract debriefing sessions.

Planned Activities for FY 1987/88:

1. Completion of underground communications systems contract (1989).

2. Completion of underground stability evaluation with particular reference to en echelon lensed orebodies (1989).

3. Completion of a geotechnical data base and a numerical modelling package for the design of underground openings at depth (1989).

4. Delayed backfill consolidation (June 1987).

Rockburst Research

Project Leader: D. Hedley
(705) 848-2236

Person Years - 5.0
A-Base Operating and Maintenance - $310,000
Contracts - $0.00

Objective:

To develop new seismic equipment and monitoring techniques for studying rockbursts in mines; to carry out seismic studies at mines in Sudbury, and at other Ontario locations; to relate seismic activity to stress, displacement and fill pressures at these mines.

By 1990; to develop a national centre of expertise at the Elliot Lake laboratory;

By 1990; to produce a manual on rockbursts for the use of the Canadian mining industry.

Background:

CANMET has maintained an extensive program of rock mechanics R&D over the years. The prime thrust of this work in underground hardrock mines has been to improve safety and productivity. Design guidelines have been developed for a number of mining methods and support techniques.

In 1985 a Memorandum of Agreement was signed between Canada, the government of Ontario and that Province/Mining industry for a five year rockburst research project with Tripartite funding.

This project has been organized with tripartite funding from the Federal Government, the Government of the Province of Ontario, and the Ontario mining industry.

The Federal Government's contribution, through CANMET, is to provide staff to operate the project, training, and maintenance of equipment.

The government of the Province of Ontario is providing funds for equipment and services. Participation is through the Ministries of Labour, Natural Resources, Northern Development and Mines.

The Ontario mining industry is contributing through the use of its existing microseismic systems as well as with the installation of new equipment at its mines. Companies participating in this project at present are: Campbell Red Lake Mines Limited, Denison Mines Limited, Falconbridge Limited, INCO Limited, Lac Minerals Limited, and Rio Algom Limited.

Rockbursts, such as occur in the Canadian Pre-Cambrian Shield, are attributed to the stress redistributions which accompany mining in hard rock formations. Microseismic activity, which accompanies the stress increase preceeding rockbursts, is viewed as having the potential to locate areas in which rockbursts may occur and, perhaps, to provide a means of sort-term prediction prior to occurence.

Although microseismic systems have been used experimentally in mines for many years, marginal advances in methodology and equipment development have limited their use. This is attributed in part to mine utilization philosophy, staff turnover, and the limited market for equipment which could be developed.

Source location is the objective of the existing, or planned, eleven Canadian microseismic systems. The research on rockbursts which is proposed would involve investigation, development and testing of equipment and methodologies directed at improving the location of microseismic build-up, identifying the mechanisms of energy release, and, in some cases, warning of impending rockbursts.

The first two years of the rockburst project are mainly concerned with developing new seismic instrumentation which incorporates wave form analysis. These systems, with other more conventional rock mechanics instrumentation, will be tested at mines in Red Lake, Elliot Lake, Kirkland Lake and Sudbury.

In addition, basic microseismic research work will continue on measurements and analyses of stresses and displacements and computer modelling of hardrock mines.

Technology Transfer:

The following methods of technology transfer are evisaged:

1. Preparation of technical/contract reports, and/or publication of results in scientific journals.

2. Technology transfer seminars or contract debriefing sessions.

Planned Activities for FY 1987/88:

1. Installation of seismograph stations at Sudbury, Elliot Lake, Red Lake and Kirkland Lake (1987).

2. Annual report of Canada/Ontario/Industry rockburst project.

3. Installation of new macroseismic network at the Strathcona mine.

4. Report on microseismic/rockburst research in Canada.

5. Report on seismic source location techniques.

6. Installation and testing of new macroseismic network (Noranda System) above the Quirke mine.

7. Installation of triaxial sensors and waveform equipment at the Campbell and Macassa mines.

8. Review of rockburst incidents in Ontario mines during 1986.

9. Installation of new macroseismic network around the Creighton mine.

10. Review of distress blasting techniques in Ontario mines.

Canada/Ontario Mineral Development Agreemnt

Project Leader: R.W.D. Clarke
(613) 995-1147

Person Years - 1.0
A-Base Operating and Maintenance - $62,000
- $90,000 MDA
Contracts - $801,000 MDA

Objective:

To improve productivity and safety in underground hardrock mines by optimizing the support capabilities, placement techniques and engineering design procedures for both sand and rock backfills; and to develop multi-purpose software suitable for use on computers at small mines.

By 1988; to develop a small specialized backfill laboratory at Sudbury.

Background:

The current directions in the Canada/Ontario Mineral Development Agreement research are based on the amount of backfill used and planned to be used in the industry and on the high cost of present consolidating agents. If modelling, and hence planning, can offer improved stability by determining optimal placement strategies in the mining cycle, and if a detailed investigation of backfill engineering properties can yield cheaper, stiffer backfills, then, the resultant economies will make more reserves in areas where the development cost has already been paid.

At the same time, computing has revolutionized every aspect of engineering and management. The Canada/Ontario Mineral Development Agreement recognizes the need for a unified direction in program creation by issuing a contract on computer specifications. The industry has been plagued with a myriad of "solutions" which only run on some very specific hardware and, consequently, programs are not getting a wide enough trial to establish utility and the mining industry is being poorly served by software manufacturers. At the other end of the computing spectrum, large programs have seldom been within reach of the mining user. The need is clear because metal economics favours bulk methods and reserves are at depth in established mines. These forces have combined to promote a significant new approach in three dimensional modelling of entire orebodies.

Technology Transfer:

The following methods of technology transfer will be used:

1. Joint projects with industry;
2. Meetings with company, union, regulatory officials;
3. Jointly authored technical reports with industry;
4. Participation in industrial seminars.

Planned Activities for FY 1987/88:

1. Report on in situ backfill properties of dewatered tailings (1987).
2. Report on situ monitoring and computer modelling for mining beneath a cemented fill mat (1987).
3. Report on use of cemented fills for controlling violent pillar failures (1989).
4. Evaluations and validations of large-scale computer models for simulating the statistics of systems of mine openings at depth (1990).
5. Evaluation of backfill alternatives and placement techniques for economic optimization (1990).

MINERAL RESERVES ASSESSMENT

Reserve Assessments

Project Leader: A. Füstos
(613) 996-4570

Person Years - 2.0
A-Base Operating and Maintenance - $116,000
Contracts - $0.00

Objective:

To provide regular updates of economically mineable uranium reserves and associated inferred resources;

To determine the ore reserves of specified mineral deposits to meet departmental information requirements; and

To develop new ore reserve evaluation methodologies for the assessment of reserves and related economic evaluations.

Background:

The determination of uranium reserves and associated inferred resources in Canadian deposits was assigned to MRL/CANMET by Cabinet order in 1974. For reliable uranium resource and resource assessments it was necessary to obtain primary core drilling data from all companies with relevant deposits. Over the subsequent years this has been done. For computer storage of such data and the requried assessment calculations and evaluations, it was necessary to develop two parallel sequences of reserve assessment computer programs (CADD and GEM). Over time this has been done and the complete sets of programs are now being made available to the public.

Only economically mineable reserves and resources of uranium in Canada are included in confidential national reports, as the basis for annual published aggregated results. Accordingly, it has been necessary to estimate mining costs and conduct simple economic price analyses assigned by URAG, which are used to establish lower limit cutoff grades for reserve assessment.

Independently estimated mineable uranium reserves and resources are required as input to government (URAG) policy decisions on domestic and export quotas for Canadian utilities and uranium producing operations, as well as the granting of licences by AECB. In addition, projections of future Canadian uranium production by companies are required internally, as well as in aggregated form for international agencies such as the International Atomic Energy Agency (IAEA).

Technology Transfer:

Each uranium reserve and resource assessment by the MRL Ore Reserve Assessment Group, on behalf of URAG, is reviewed with individual staff representatives of relevant individual company exploration or mining projects. All procedures and results are shared and questions pertaining to methodology are resolved.

All assessment procedures and related computer programs, which have been developed by MRL Ore Reserve Assessment Group, are passed to appropriate staff members of uranium exploration and mining companies. Meetings are arranged to review procedures pertinent to each specific situation and to ensure that technology transfer occurs in a meaningful way.

As noted, all of the programs developed to date for uranium reserve and resource assessment are now being made available to the public.

Planned Activities for FY 1987/88:

1. Periodic reports on Canadian uranium reserves deposit-by-deposit, including significant general information on the status of each.

2. Report of new computer-based methodologies for evaluating uranium and other mineral reserves and resources, including procedures utilizing conventional, geostatistical, and global statistical multiple cut-off systems (annually).

MINE ENVIRONMENT

Ventilation and Respirable Dust

Project Leader: J. Bigu
(705) 848-2236

Person Years - 4.0
A-Base Operating and Maintenance - $232,000
Contracts - $30,000

Objective:

By 1990; to develop and design a new dust tunnel at the Elliot Lake Laboratory for the studies of airborne particulate contaminants; to determine the concentrations of mineral particulates in mine air at various locations and to investigate control measures; to demonstrate continuous environmental monitoring systems underground; and to verify mine ventilation models and modify them to meet application requirements.

Background:

Dust is a significant factor affecting the long-term health of the work force in all mining operations. Dust from certain minerals can lead to lung disease. Lubricating oil mists and diesel exhaust also carry noxious dust and gases. In addition, in uranium mines dust particles can carry radon and thoron daughters and long-lived radionuclides into the lung where radiation, mostly alpha-particles, emitted internally may give rise to tissue damage.

There is a need to improve measurement techniques, i.e., instrumentation and methods, and programs to better assess and predict personal dust exposure. The original of respirable dust, and its composition and size distribution among other factors, must be known in order to determine effective control measures and to guide and interpret epidemiological and medical studies. This work requires developing an extensive data base through sampling in mines with improved dust instrumentation. It also requires adequate test and calibration facilities in order to determine the performance, quality and accuracy of dust instrumentation.

Control measure efforts centre in improving breakage and rock handling techniques to minimize dispersion of dust into the air, filtration of airborne dust, wetting techniques, as well as optimizing mine layout and ventilation. Ultimately, optimum control methods should be built directly into mine equipment and mining methods.

Technology Transfer:

Cooperation with mining companies is essential in much of the experimental work on this project, both through the use of operating mine facilities for collecting samples and through collaborative projects. Technology transfer is thus effected directly to the companies involved as well as through report dissemination, technical presentations, seminars and workshops. The data obtained are also made available to government agencies, federal and provincial, through the above channels.

Planned Activities for FY 1987/88:

1. Conduct field studies on dust control techniques and methods in hardrock mines (December 1987).

2. Evaluate dust tunnel test facility (August 1987).

3. Conduct ventilation studies (e.g. recirculation in U/G mines as a means of controlling atmospheric pollutants (December 1987).

4. Studies on the electrical characteristics of dust (March 1987).

Radiation

Project Leader: J. Bigu
(705) 848-2236

Person Years - 5.0
A-Base Operating and Maintenance - $290,000
Contracts - $30,000

Objective:

By 1990; to establish, and operate on a cost-recovery basis a national calibration facility for instruments measuring radon, thoron and their decay products; to quantify long-lived radioactive dust by gamma-spectroscopy; to complete studies on radiation control procedures using a number of different methods and to complete verification of radiation mine models and modification models, on the basis of experimental data for practical application, combined with ventilation and dust models.

Background:

Radiation exposure to uranium mine personnel can be controlled basically by limiting the time of exposure, protecting the worker (e.g., shielding), and by reducing the radiation level. Ventilation is an effective way of reducing radiation levels at working sites. However, there are other methods that may prove to be both effective and economical in helping to control and/or minimize radiation levels.

Such methods include (1) coating mine walls with certain chemical agents (sealants) to reduce radon and thoron migration through mine walls; (2) use of mixing fans to eliminate decay products by plate-out on the fan blades and on wall surfaces due to convective air currents set-up by the fan; (3) use of DC electrical fields to remove decay products by electrostatic precipitation; and (4) use, in certain cases, of special "loose" filter materials with electret properties to remove decay products by mechanical trapping and electrostatic precipitation.

The measurement of mine radiation levels and exposure dose to workers is of utmost importance from the health physics, occupational and engineering standpoints. Furthermore, reliable experimental radiation data very much depends on adequate performance of monitoring instrumentation. Hence proper testing procedures and calibration of radiation instruments are important.

In this light, the establishment of a large test facility for radon, thoron and their decay products is indispensable. Finally, the Internatinal Commission on Radiological Protection (ICRP) has recently made recommendations regarding limits of exposure to long-lived radioactive dust in relation to total dose exposure to external gamma-radiation and airborne alpha-emitters (i.e., radon and thoron daughters in the submicron and respirable range). Hence, identification and quantification of long-lived radioactive dust has become an important issue.

Technology Transfer:

Cooperation with mining companies is essential in much of the experimental work on this project, both through the use of operating mine facilities for collecting samples and through collaborative projects. Technology transfer is thus effected directly to the companies involved as well as through report dissemination, technical presentations, seminars and workshops. The data obtained are also made available to government agencies, federal and provincial, through the above channels.

Planned Activities for FY 1987/88:

1. Characterize long-lived radioactive dust and other airborne pollutants (June 1987).

2. Develop radiation/aerosol/ventilation models and validate models experimentally (November 1987).

3. Optimize and/or develop techniques to control radiation in mines (March 1988).

4. Establishment of National test facility for radon, thoron, and their daughter products (1987).

5. Continuation of personal dosimetry program (March 1987).

EXPLOSIVE ATMOSPHERES

Fire and Explosion Hazard R&D

Project Leader: K.J. Mintz
(613) 996-4570

Person Years - 2.4 (A-Base)
A-Base Operating and Maintenance - $139,000
Person Years (ERD)
A-Base Operating and Maintenance - $181,000 (ERD)
Contracts - $135,000 (ERD)

Objective:

To characterize the explosion hazards of Canadian dusts on demand or by systematic R&D; to collaborate in the determination of the best manner of controlling sulphide ore dust explosions in Canadian mines; to develop a method for evaluating the thermite reaction hazard resulting from impact on light alloys; to establish a larger test chamber for improved characterization of dust explosion parameters.

Background:

CEAL has been active since its inception in the field of accidental gaseous explosions, and has established a reputation in that field. The dust explosion project was transferred to CEAL from CERL in FY85-86, but delays in renovation of the building delayed the commissioning of the new dust explosion laboratory until FY 86/87. The general thrust during the next few years will be to establish the laboratory as a national centre of expertise for dust explosions. The major particular thrust over the next two years will be to investigate, on a laboratory and field basis, sulphide ore dust explosions which have recently become recognized as a serious problem in Canadian mines.

Technology Transfer:

Mining companies and mining inspectorates will benefit from scientific papers, internal reports, etc., as studies develop. Other industries can obtain information, verbal and written, on development of standards and explosion hazards. Laboratory test reports are available as requested (cost recovery).

Planned Activites for FY 1987/88:

1. Determine the stress effects of ultra-high speed pressure application to metal explosion proof enclosures (1987).

2. Development of a method for evaluating the impact thermite reaction (1987).

3. Determine the explosion characteristics miner dusts (1988).

4. Commissioning of a larger-scale dust explosion chamber (1988).

5. Completion of a comprehensive CANMET Monograph on gas and dust explosion phenomena (1991).

Diesel Flameproof & Ventilation R&D:

Project Leader: E.D. Dainty
(613) 996-4570

Person Years - 3.6
A-Base Operating and Maintenance - $208,000
Contracts - $40,000

Objective:

By 1988; to formalize the design criteria for venturi scrubbing systems for transfer of technology to the private sector.

By 1988; to finalize the form of the air quality Index expression for ventilation prescription and environmental assessment.

By 1988; to complete a monograph on diesel emissions reduction and environmental assessment, and to complete the technology transfer aspects of diesel emissions reduction R&D.

Background:

CANMET/MRL/CEAL has been active for several years in the development of equipment to reduce the toxicity of diesel emissions because of the fear that productive diesel machinery was perceived by labour as posing a health hazard. This health-related work has been increasingly well-received, resulting in the world-leading role which CEAL has taken in this particular area because of the very large relative size of the Canadian underground dieselized fleet in all types of mines. This work completed a major milestone in 85/86 with the underground testing of emissions reduction equipment developed under the United States Bureau of Mines/Ontario Ministry of Labour/CANMET collaborative agreement. Less emphasis will then be placed on diesel emissions equipment development and health impact studies. However, these efforts must continue in-house on a modest basis as a support to the diesel machinery certification processes, which will need to expand because of the provinicial inspectorates requirement for the certification of non-coal mining diesel machinery (where diesel usage is mainly concentrated in Canada). This requirement will be fully implemented when the CSA standard for diesel machines underground is finalized (B.C. requires this now).

The underground environment assessment work, which parallels the above equipment development, has had two thrusts: (1) assessment of underground airborne samples in diesel environments for PAHs and mutagenesis, and (2) assessment underground of diesel environments for toxic gaseous and particulate concentrations providing an Air Quality Index (AQI) survey of Canadian mines. The R&D associated with the first has been virtually completed.

The equipment for the second will be transferred to Elliot Lake starting March 31/87 and reports on the assessment of the CONSPEC monitoring system will be written in FY 1987/88.

Technology Transfer:

Recipient Organizations	Modes of Transfer	Time Frame
1. The Canadian labour movement	1. licensing CANMET developed emissions strategies	as development completed (1986)
2. Mining inspectorates (federal and provincial)	2. the contracting-out process	1986/87
3. Mining companies (Canada-wide)	3. scientific papers and internal reports	as studies completed
4. Mining machinery companies (canada and abroad)	4. development of standards for acceptable underground atmosphere	national diesel code slated for 1985
	5. provision of seminars of diesel impact on environment	on demand
	6. IRAP/PILP ceramic filter agreement	1986/87

Planned Activities for FY 1987/88:

1. Continuance of on-going in-house certification-related emissions R&D in collaboration with Canadian private sector firms and other government agencies. Finalization of the AQI for ventilation prescription and environmental assessment (1988).

2. Privatization/commercialization of venturi scrubbing systems (1989).

3. Privatization/commercialization of ceramic filter systems (1989).

4. Completion of CANMET monograph on diesel emissions and underground environmental assessment (1989).

EQUIPMENT SAFETY CERTIFICATION

Equipment Certification and Testing

Project Leader: G. Lobay
(613) 996-4570

Person Years - 3.7
A-Base Operating and Maintenance $214,000
Contracts - $0.00

Objective:

To provide, on a continuing basis, a certification service to Federal and Provincial Inspection authorities for apparatus and materials intended for use in underground mines.

To provide testing services in support of the certification service, as well as contract testing services to clients seeking evaluation of apparatus and materials for use in industries where explosive gas and/or dust hazards may exist.

Background:

The certification service was started in 1955 at the request of the Provincial Ministers of Mines, who saw a need for a Canadian certification service for equipment and materials for use in underground coal mines. This service is provided to manufacturers or users on a cost-recovery basis. The major outputs are certificates issued (currently about 80 per year) and a published list of certified products.

Whenever possible, these certificates are based upon conformance with national concensus standards. Because of EMR's involvement as a certifying body, our input is required (as committee members) in a number of technical committees.

Because there is no other organization in Canada performing testing services in explosive atmospheres, this service is also made available to other Canadian companies and organizations on a cost-recovery basis.

Technoloy Transfer:

1. Confidential reports on test results are made available to the submittors of equipment and materials.

2. A list of certified products is published annually and given wide distribution to the mining industry.

3. A report of our activities is given to the annual meeting of the Chief Inspectors of Mines.

4. Courses are given to mine inspectors and mine maintenance personnel on how to safely repair flameproof equipment.

5. Advice and guidance is given to designers of Canadian built flameproof equipment particularly those working under Federal government contracts.

Planning Activities for FY 1987/88:

1. Certificates for flameproof and intrinsically safe electrical equipment, gas detection equipment, diesel powered equipment, fire resistant materials for use in underground mines, (conveyor belts, electric cables, hydraulic fluids, ducts etc.)

2. Annual list of certified equipment and materials for use in underground mines.

3. Development of improved facilities for explosion testing (1987).

Quality Assurance

Project Leader: G. Lobay
(613) 996-4570

Person Years - 1.2
A-Base Operating and Maintenance - $69,000
Contracts - $0.00

Objective:

To monitor the continuing compliance of apparatus and materials certified by EMR after certification.

Background:

In 1984, EMR and the Canadian Standards Association signed a Memorandum of Understanding which included a provision for CEAL to utilize CSA's extensive factory inspection network which operates on a world-wide basis. This has enabled CEAL to set up a system of programmed factory inspections to ensure that certified equipment and materials continue to meet EMR's requirements after the certificate has been issued.

Technology Transfer:

	Recipient Organization	Mode of Transfer	Time Frame
1.	All manufacturers having certificates	Visit from an inspector from CSA or CEAL	Annually
2.	Manufacturers of fire-resistant materials	Re-test of fire-resistant materials	Annually

Planned Activities for FY 1987/88:

1. Annual visits to all manufacturers holding regular certificates for equipment and materials used in underground mines by membership on standards-writing committees and related research, and fostering of international standards.

Standards Development

Project Leader: J.A. Bossert
(613) 996-4570

Person Years - 2.1
A-Base Operating and Maintenance $122,000
Contracts $0.00

Objective:

To participate in the development of standards related to equipment and materials used in underground mines by membership on standards-writing committees and related research, and fostering of international standards.

Background:

As part of the equipment and materials certification for underground mines, Canadian standards are required in order that the certificates are based upon fair and reasonable requirements. CEAL participates in the writing of these standards by participation in technical committees operating on a National and International basis and, in addition, performs research studies on new test methods proposed in order to assist these committees in their deliberations.

Technology Transfer:

1. Reports of research on this subject are circulated as published to all interested parties including manufacturers, mine inspectors and mine owners.

2. CEAL personnel serve on technical committees of several recognized standards writing bodies including the International Electrotechnical Commission (IEC), International Standards Organizatin (ISO), Canadian Standards Association (CSA), Instrument Society of America (ISA), and Canadian Gas Association(CGA).

Planned Activities for FY 1987/88:

1. Draft Canadian standards currently under preparation, and eventually to be published as National Standards of Canada, include: mine ventilation materials and portable blasting machines (1987).

2. International standards for electrical equipment for use in explosive atmospheres, fire-resistant hydraulic fluids and flame retardant conveyor belting.

3. Revision of existing standards to keep up with new technology.

ENVIRONMENTAL CONTROLS

Mine/Mill Waste Management

Project Leader: N. Davé
(705) 848-2236

Person Years - 3
A-Base Operating and Maintenance - $154,000
Contracts - $75,000

Objective:

To develop methods/technology for the management of mine/mill waste to reduce environmental impact.

Background:

The development of methods for the minimization of the environmental impact of mine/mill waste involves both laboratory and field investigations. The Elliot Lake Laboratory of CANMET is uniquely situated to undertake studies on the methods for the safe disposal of mine/mill wastes, surface stabilization by vegetative cover, and environmental pathways for contaminants migration.

The disposal technique may be the conventional land-based tailings management system, in which the tailings surface and effluent will require treatment to reduce the effects of weathering and other natural forces. In some special cases the disposal may be underwater in deep lakes to minimize the oxidation of metal sulphides, in which case the stability under the applicable conditions must be known. Suitability of vegetative cover and other chemical surface stabilization techniques have to be evaluated for land-based management systems for their role in minimizing leaching, contaminant migration via surface and groundwater flow regimes and uptake of contaminants by the plants and various other inhabitants of the waste management program.

CANMET's role will consist of the demonstration and evaluation of methods such as vegetating the tailings pile surfaces and other engineering cover techniques, for monitoring their effectiveness, and identifying and evaluating the mechanisms which tend to promote release of environmental contaminants from them through - soil development, water movement, and food chain pathways.

The knowledge acquired from these studies will assist federal and provincial government agencies in the formulation of policies for the development of their mineral resources which will permit enjoyment of their socioeconomic health hazards in the near future.

The base metals and uranium mining companies will benefit from the results of this project, including Provincial and Federal governments through their financial holdings in some of these.

Technical Transfer:

Through reports, publications, seminars and work shops.

Planned Activities for FY 1987/88:

1. Evaluation of th geochemistry of a thickened tailings disposal system (uranium tailings) (1989).

2. Consolidation of tailings using lime, cement and slag cement for in-situ and back filling operations (uranium tailings) (1990).

3. Evaluation of various tailings covers (vegetation, de-pyritized tailings, waste rock, clay, water saturated etc.) for long term physical and chemical stability (uranium and sulhide tailings) (1992).

4. Study of physical and chemical profiles of uranium and sulphide tailings basins (solid and liquid phase) (1990).

5. Study of solution transport and contaminants migration pathways from uranium and sulphide tailings (1990).

6. Pathway analysis and contaminants migration in over-burden and bedrock underneath the tailings (1991).

7. Development and assessment of a contaminant migration model (1992).

APPENDIX A

Contractor:	Mining Resource Engineering Limited
Scientific Authority:	K.K. Feng
Title:	Theoretical Model for Predicting Low Velocity Impact Sensitivity Bubble Explosion
Contract Value:	$105K

Contractor:	Cominco Limited
Scientific Authority:	G. Herget
Title:	To Carry our Field & Laboratory Testing, Field Measurements & Numerical Modelling of Excavations in Potash
Contract Value:	$90K

Contractor:	J.S. Redpath Limited
Scientific Authority:	R.W.D. Clarke
Title:	Estimated Preproduction & Operating Costs of Mining Small Mineral Deposits by underground Methods (UP-R-237)
Contract Value:	$97.39K

Contractor:	Brunswick Mining & Smelting
Scientific Authority:	N. Billette
Title:	Canada/New Brunswick - Task 2: Development of a Mine Services Software System
Contract Value:	$330K

Contractor:	Davis Engineering Limited
Scientific Authority:	J. Pathak
Title:	Design & Development of a Blasthole Depth Measurement Test Set
Contract Value:	$107K

Contractor:	Noranda Mines Limited
Scientific Authority:	M. Gangal
Title:	Utilization of CO-2 and an Engineering Control Parameter for Automated Mine Ventilation ($57K Noranda - UP-N6-018)
Contract Value:	$107K

Contractor:	Denison Potacan Potash Company
Scientific Authority:	G. Herget
Title:	New Brunswick MDA - Use of Backfill in New Brunswick Potash Mines
Contract Value:	$214.74K

Contractor:	International Minerals & Chemical Corporation
Scientific Authority:	G. Herget
Title:	Identification of Input Parameters for Numerical Modelling of Potash Strata at IMC (UP-I-192)
Contract Value:	$66K

Contractor:	Central Canada Potash
Scientific Authority:	S. Vongpaisal
Title:	Regional Subsidence Related to Potash Mining
Contract Value:	$50K

Contractor:	Potash Corporation of Saskatchewan
Scientific Authority:	D.G.F. Hedley
Title:	Research on Microseismic Technology
Contract Value:	$40K

Contractor:	C. Mirza Engineering
Scientific Authority:	M. Bétournay
Title:	Sampling, Field Testing and Modelling of a Surface Crown Pillar, Les Mines Selbaie, Québec
Contract Value:	$99.62K

Contractor:	Noranda Research Centre
Scientific Authority:	D. Hedley
Title:	Development of a State-of-the-Art Microseismic Monitoring System (UP-N-204)
Contract Value:	$320.71K

Contractor:	Dome Mines Limited
Scientific Authority:	A. Annor
Title:	Ontario MDA, Part I: In Situ Determination of Dewatered Tailings Fill Properties in Ontario Mines
Contract Value:	$152.58K

Contractor:	INCO Limited
Scientific Authority:	A. Annor
Title:	Ontario MDA, Part II: In Situ Determination of Dewatered Tailings Fill Properties in Ontario Mines
Contract Value:	$112K

Contractor:	Falconbridge Limited
Scientific Authority:	A. Annor
Title:	Ontario MDA, Task 2: In Situ Monitoring & Computer Modelling of a Cemented SIll Mat & Confines During Tertiary Stage Pillar Recovery
Contract Value:	$154.72K

Contractor:	Denison Mines Limited
Scientific Authority:	D. Hedley
Title:	Ontario MDA, Task 3: Use of Consolidated Fills for Controlling Violent Pillar Failure in Ontario Mines
Contract Value:	$610K

Contractor:	Falconbridge Limited
Scientific Authority:	A. Annor
Title:	Ontario MDA, Task 5: In Situ Properties of Backfill Alternatives In Ontario Mines
Contract Value:	$470K

Contractor:	INCO Limited
Scientific Authority:	Y.S. Yu
Title:	Ontario MDA, Task 6: Simulation of Bulk Mining at Depth with Backfill in Ontario Mines
Contract Value:	$1,000K

Contractor:	Dome Mines Limited
Scientific Authority:	A. Annor
Title:	Ontario MDA, Task 7, Part III: Liquefaction of Potential of Dense Backfill
Contract Value:	$125.25K

Contractor:	Sherritt Gordon Mines
Scientific Authority:	S. Vongpaisal
Title:	Manitoba MDA, Task 2: Ground Stability Evaluation with Reference to Echelon Lensed Orebody
Contract Value:	$289.19K

Contractor:	Sherritt Gordon Mines
Scientific Authority:	S. Vongpaisal
Title:	Manitoba MDA, Task 3: Communication System for Isolated Areas in Mines
Contract Value:	$429.40K

Contractor:	INCO Limited
Scientific Authority:	Y.S. Yu
Title:	Manitoba MDA, Task 4: Geomechanical Data Base for Ground Control in Deep Mines
Contract Values:	$255.55K

Contractor:	INCO Limited
Scientific Authority:	Y.S. Yu
Title:	Manitoba MDA, Task 1: Develop Vertical Block Method Design Guidelines for Steeply Dipping Orebody Techniques
Contract Value:	$362.50K

Contractor:	INCO Limited
Scientific Authority:	J. Pathak
Title:	Manitoba MDA, Part III, Task 5: Optimization of Blast Design for Blasthole Mining Operators
Contract Value:	$260K

Contractor:	Hudson Bay Mining & Smelting
Scientific Authority:	A. Annor
Title:	Manitoba MDA, Task 6: Delayed Backfill Consolidation
Contract Value:	$100K

Contractor:	McGill University
Scientific Authority:	E.D. Dainty
Title:	The Influence of Trubulence on Dust-Air Explosions
Contract Value:	$40K

Contractor:	University of Sydney
Scientific Authority:	E.D. Dainty
Title:	Synthesis of Current Knowledge of Sulphide Ore Dust Explosion Phenomena
Contract Value:	$18K

Contractor:	Ian W. French & Associates
Scientific AUthority:	E.D. Dainty
Title:	Addendum to "Health Implications of Exposure of Underground Mine Workers to Diesel Exhaust Emissions - Update"
Contract Value:	$10K